DOCUMENT RESUME

ED 270 329 SE 046 640

TITLE Engineering Education Problems: A Guide to Legislative Action for NSPE State Societies.
INSTITUTION National Society of Professional Engineers, Washington, D.C.
PUB DATE Jan 86
NOTE 37p.
AVAILABLE FROM NSPE, 1420 King Street, Alexandria, VA 22314. ($20 non-members, $10 members; publication No. 1016).
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Case Studies; College Science; Data Analysis; Data Collection; *Engineering Education; Equipment; Evaluation; *Laboratory Equipment; Obsolescence; *Politics of Education; *Resource Materials; Science Education; Teacher Salaries; *Teacher Shortage; Teacher Student Ratio
IDENTIFIERS *National Society of Professional Engineers

ABSTRACT

This document is intended to serve as a resource for state societies of the National Society of Professional Engineers (NSPE) in the preparation of action plans targeted at legislative changes in support of engineering education. The results of action taken recently by various state legislatures in response to NSPE state society activities are reviewed. Guidelines for development of an action plan include publication of pertinent data (Appendices A and B provide examples), lobbying, Political Action Committee involvement, hints for contacting legislators (Appendix C), hints for contacting media (Appendix D) and useful source documents (Appendix E). A guide to implementation of the action plan poses such questions as: (1) What resources are needed to solve the problem?; (2) What form should the resources take?; and (3) For how long should the resources be provided? Summaries of case studies of successful initiatives from New Mexico, Illinois, Missouri, Pennsylvania and Michigan are provided. (JM)

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ENGINEERING EDUCATION PROBLEMS:

A Guide to Legislative Action for NSPE State Societies

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ENGINEERING EDUCATION PROBLEMS:

A Guide to Legislative Action for NSPE State Societies

Professional Engineers in Education
a practice division of the
National Society of Professional Engineers

1420 King Street
Alexandria, Virginia 22314

January 1986

PREFACE AND ACKNOWLEDGEMENTS

In 1982, the Education Committee of the National Society of Professional Engineers and the Society's Professional Engineers in Education practice division developed and produced a publication designed to aid NSPE state societies in responding to the crisis that was facing engineering education at that time. A number of state professional engineering societies have since taken the lead in identifying and addressing the needs of engineering education in their states, specifically the serious problems of faculty shortage and equipment obsolescence.

This second edition of *Engineering Education Problems: A Guide to Legislative Action for NSPE State Societies* represents an update on their legislative accomplishments and reflects what states have learned thus far about the effective development and implementation of strategies for securing aid.

The Professional Engineers in Education practice division of the National Society of Professional Engineers wishes to acknowledge the outstanding work of all state societies now addressing the critical needs of engineering education and most particularly those featured in these pages.

We also wish to thank the Engineering Deans Council, the American Society for Engineering Education, the National Research Council, the Engineering Manpower Commission of the American Association of Engineering Societies and the National Science Foundation for their contributions to this guide.

Above all, we wish to thank the participants of the NSPE/PEE Sustaining University Program, without whose support this publication would not have been possible.

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1985–86 Chairman, Professional Engineers in Education

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This publication was made possible through funds provided by NSPE's Professional Engineers in Education Sustaining University Program. Contributors for 1985 included:

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National Society of Professional Engineers
1420 King Street, Alexandria, Virginia 22314

NSPE Publication No. 1016
1000 CPS 1986
$10 NSPE members $20 non-members

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1 Target Areas Of Need

". . . The most critical and concerned attention directed at the engineering profession in recent years has focused on engineering education. This is where the cries of crisis have been most frequent and insistent. The educational system is correctly perceived as producing not just the fodder of the technology development process, but its seed corn as well. The training, skills, and knowledge of recent graduates are of critical importance to that development process, and trends that threaten their continued supply to any degree also threaten the foundations of industry and the national economy."

—National Research Council, Committee on the Education and Utilization of the Engineer, 1985

The early 1980s marked a turning point nationwide in a greater awareness of and response to the seriousness of the needs of engineering education. The dramatic growth in undergraduate engineering enrollments, coupled with the attractiveness of work in industry, had led to a severe shortage of qualified faculty; essential laboratory equipment was seriously outdated (the average age estimated at twice the age of equipment found in industry); and Ph.D. candidates, the source of future faculty, had dipped to an alarmingly low number.*

Since then, a heightened awareness of these problems has been felt not only on the national level but on the state level as well. Just as national policy makers are recognizing the impact of the quality of engineering education on the United States' ability to compete successfully in industrial world markets, so, too, a growing number of state legislators are recognizing the link between the strength of a state's engineering education capability and its economic health. The map on pages 2 and 3 represents recent progress made by a number of NSPE state societies to obtain public and private funding for laboratory equipment and faculty compensation.

Though these successes have done much to alleviate the "crisis" situation in engineering education, the need for continued and effective action remains. The most critical needs continue to be in the areas of assuring adequate number of faculty and providing up-to-date laboratory equipment for both research and instruction.

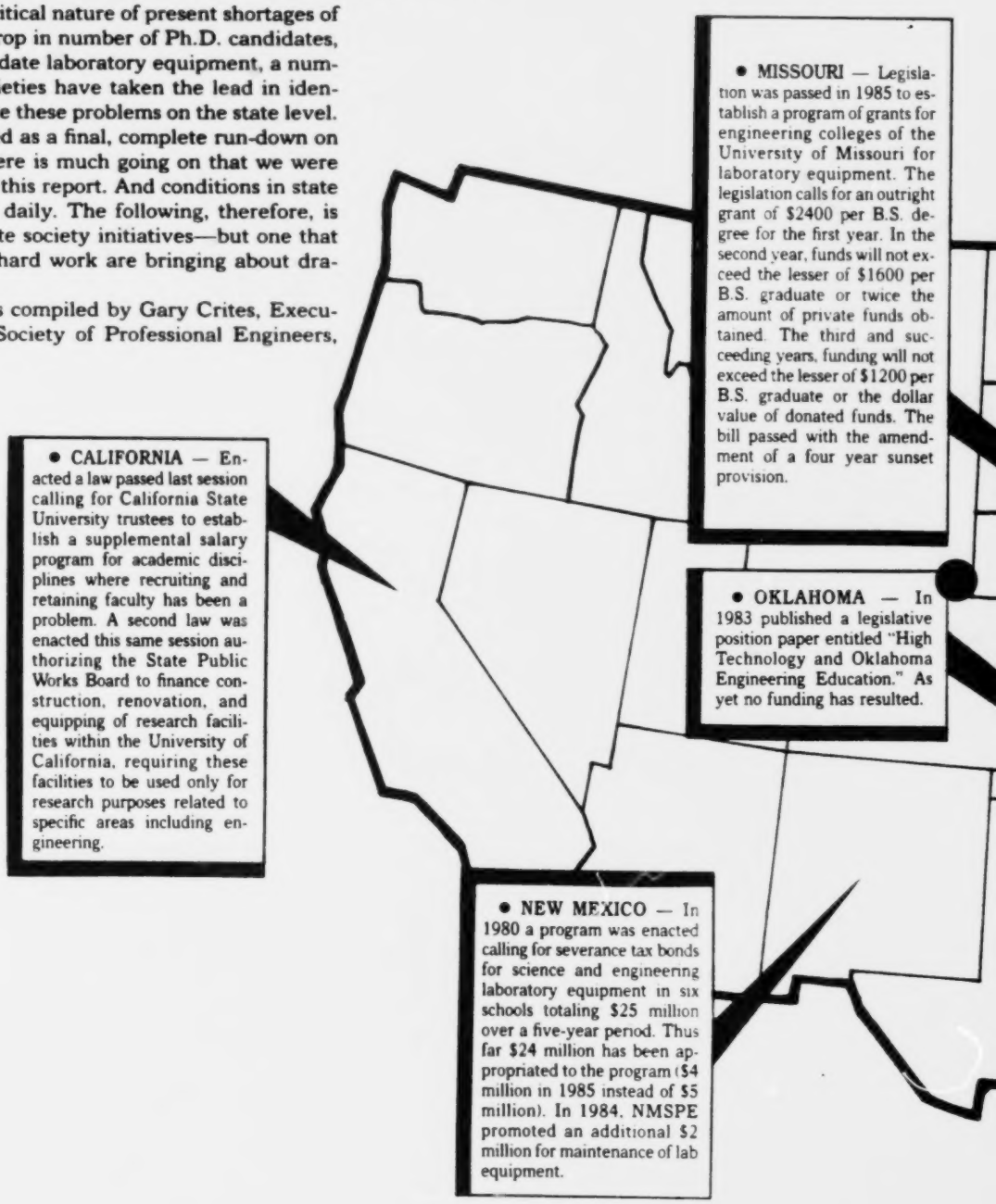
*A list of source documents for this data is found in Appendix E; see also "Useful Facts and Figures," Appendix A.

Engineering Education Funding: State Society Initiatives

Recognizing the critical nature of present shortages of qualified faculty, the drop in number of Ph.D. candidates, and the need for up-to-date laboratory equipment, a number of NSPE state societies have taken the lead in identifying and helping solve these problems on the state level.

This is not intended as a final, complete run-down on legislative activity. There is much going on that we were unable to condense for this report. And conditions in state capitals change almost daily. The following, therefore, is a mere sampling of state society initiatives—but one that shows how vision and hard work are bringing about dramatic results.

This summary was compiled by Gary Crites, Executive Director, Illinois Society of Professional Engineers, Inc.

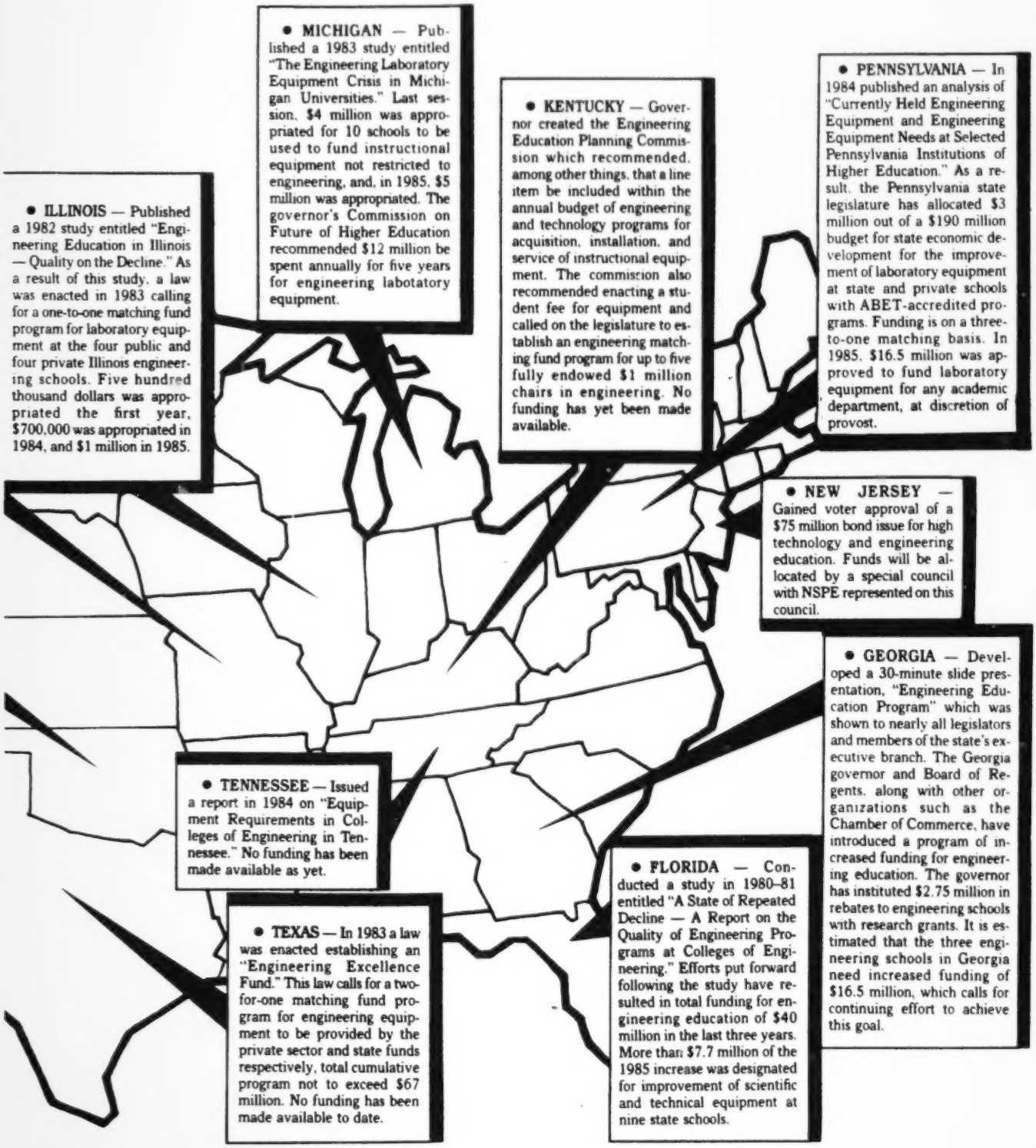


• **CALIFORNIA** — Enacted a law passed last session calling for California State University trustees to establish a supplemental salary program for academic disciplines where recruiting and retaining faculty has been a problem. A second law was enacted this same session authorizing the State Public Works Board to finance construction, renovation, and equipping of research facilities within the University of California, requiring these facilities to be used only for research purposes related to specific areas including engineering.

• **MISSOURI** — Legislation was passed in 1985 to establish a program of grants for engineering colleges of the University of Missouri for laboratory equipment. The legislation calls for an outright grant of $2400 per B.S. degree for the first year. In the second year, funds will not exceed the lesser of $1600 per B.S. graduate or twice the amount of private funds obtained. The third and succeeding years, funding will not exceed the lesser of $1200 per B.S. graduate or the dollar value of donated funds. The bill passed with the amendment of a four year sunset provision.

• **OKLAHOMA** — In 1983 published a legislative position paper entitled "High Technology and Oklahoma Engineering Education." As yet no funding has resulted.

• **NEW MEXICO** — In 1980 a program was enacted calling for severance tax bonds for science and engineering laboratory equipment in six schools totaling $25 million over a five-year period. Thus far $24 million has been appropriated to the program ($4 million in 1985 instead of $5 million). In 1984, NMSPE promoted an additional $2 million for maintenance of lab equipment.



• **ILLINOIS** — Published a 1982 study entitled "Engineering Education in Illinois — Quality on the Decline." As a result of this study, a law was enacted in 1983 calling for a one-to-one matching fund program for laboratory equipment at the four public and four private Illinois engineering schools. Five hundred thousand dollars was appropriated the first year, $700,000 was appropriated in 1984, and $1 million in 1985.

• **MICHIGAN** — Published a 1983 study entitled "The Engineering Laboratory Equipment Crisis in Michigan Universities." Last session, $4 million was appropriated for 10 schools to be used to fund instructional equipment not restricted to engineering, and, in 1985, $5 million was appropriated. The governor's Commission on Future of Higher Education recommended $12 million be spent annually for five years for engineering labotatory equipment.

• **KENTUCKY** — Governor created the Engineering Education Planning Commission which recommended, among other things, that a line item be included within the annual budget of engineering and technology programs for acquisition, installation, and service of instructional equipment. The commission also recommended enacting a student fee for equipment and called on the legislature to establish an engineering matching fund program for up to five fully endowed $1 million chairs in engineering. No funding has yet been made available.

• **PENNSYLVANIA** — In 1984 published an analysis of "Currently Held Engineering Equipment and Engineering Equipment Needs at Selected Pennsylvania Institutions of Higher Education." As a result, the Pennsylvania state legislature has allocated $3 million out of a $190 million budget for state economic development for the improvement of laboratory equipment at state and private schools with ABET-accredited programs. Funding is on a three-to-one matching basis. In 1985, $16.5 million was approved to fund laboratory equipment for any academic department, at discretion of provost.

• **NEW JERSEY** — Gained voter approval of a $75 million bond issue for high technology and engineering education. Funds will be allocated by a special council with NSPE represented on this council.

• **GEORGIA** — Developed a 30-minute slide presentation, "Engineering Education Program" which was shown to nearly all legislators and members of the state's executive branch. The Georgia governor and Board of Regents, along with other organizations such as the Chamber of Commerce, have introduced a program of increased funding for engineering education. The governor has instituted $2.75 million in rebates to engineering schools with research grants. It is estimated that the three engineering schools in Georgia need increased funding of $16.5 million, which calls for continuing effort to achieve this goal.

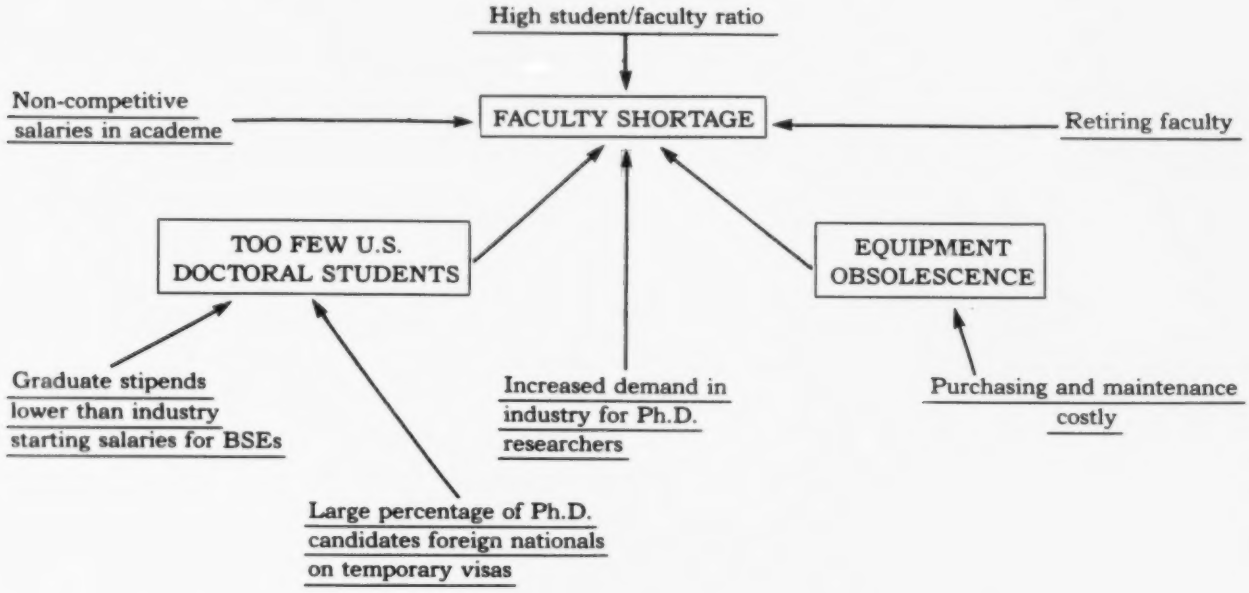
• **TENNESSEE** — Issued a report in 1984 on "Equipment Requirements in Colleges of Engineering in Tennessee." No funding has been made available as yet.

• **TEXAS** — In 1983 a law was enacted establishing an "Engineering Excellence Fund." This law calls for a two-for-one matching fund program for engineering equipment to be provided by the private sector and state funds respectively, total cumulative program not to exceed $67 million. No funding has been made available to date.

• **FLORIDA** — Conducted a study in 1980–81 entitled "A State of Repeated Decline — A Report on the Quality of Engineering Programs at Colleges of Engineering." Efforts put forward following the study have resulted in total funding for engineering education of $40 million in the last three years. More than $7.7 million of the 1985 increase was designated for improvement of scientific and technical equipment at nine state schools.

Fortunately, as the schema below illustrates, engineering education's target areas of need are interrelated—improvement in one will eventually lead to improvement in the others.

AREAS OF CRITICAL NEED: CONTRIBUTING FACTORS


High student/faculty ratio
Non-competitive salaries in academe
FACULTY SHORTAGE
Retiring faculty
TOO FEW U.S. DOCTORAL STUDENTS
EQUIPMENT OBSOLESCENCE
Graduate stipends lower than industry starting salaries for BSEs
Increased demand in industry for Ph.D. researchers
Purchasing and maintenance costly
Large percentage of Ph.D. candidates foreign nationals on temporary visas

The areas of most critical need in engineering education are the current supply of qualified instructors, the pool of future faculty and the age and condition of instrumentation for research and instruction.

The pivotal area of faculty shortage, as shown above, is a result not only of changing demographics, but of the general unattractiveness to an engineer of a career in academe. Doctoral engineers in academe are faced with both lower salaries and inferior research equipment than are engineers in industry and they are overburdened with markedly heavier teaching loads than their colleagues in other disciplines.

Working Toward Solutions

The state-wide status of each of these target areas can be monitored effectively by state engineering societies working closely with engineering faculty, department heads, deans, college presidents and governing boards. Data gathered from these sources can be used to convince state legislators that an increase in state aid is vital not only to the state's engineering colleges but to its economic health as well.

Many of NSPE's state societies have launched just this kind of campaign. Though they have enjoyed varying degrees of success, all have brought the seriousness of engineering education problems to the attention of state legislators and have increased awareness of the vital link between a strong engineering education system and technological competitiveness.

The pages which follow outline steps for initiating and implementing a state lobbying effort. Over the last several years, these guidelines have proven to be an important tool in helping a number of NSPE state societies shape legislative initiatives on behalf of engineering education. Profiles of six of the most successful efforts are also included as models for states interested in designing their own strategies. While no two efforts will be exactly alike, the basic principles involved remain the same.

2 Guidelines For Development Of An Action Plan

INTRODUCTION

To a large extent, the success of any legislative initiative depends on having a well organized plan for action and a carefully documented statement of the problem(s). This chapter describes the specific steps, methods, groups, documents and other organizational aspects of a state society's efforts to secure aid for engineering education through legislative action. For the sake of simplicity, procedures that have been effective for several states have been consolidated into one description, with critical sequences of events and procedural nuances highlighted. While not every step will be necessary for all states, the general approach should be universally applicable. It is expected that this chapter be used as a 'how to' resource, which can be distributed to all involved in legislative initiatives.

BACKGROUND

The first step to launching a legislative program is to build an awareness of the problem and motivate the society to want to secure solutions. To initiate an engineering education effort, awareness of potential or existing problems in a state's engineering colleges and their likely impact on the profession must be brought to the attention of the state society members, officers, and other leaders of the engineering community.

Over the past several years, it has become clear that the nation's future economic prosperity depends on its ability to compete for world technology markets. Linking engineering education problems to a state's ability to attract and retain engineers and other technical professionals will make the initiative relevant and important to a much broader audience. While some states are further ahead than others in recognizing the importance of engineering education to economic development, all will appreciate the significance of the issue if framed in these terms.

STATE SOCIETY SUPPORT

If the NSPE state society leadership is not involved with the genesis of the initiative, it is essential to secure their support and participation. In nearly every case, the state society will be eager to assist.

A formal commitment to a project should be made by the state society executive committee or board of directors. It may be helpful to have a dean or other knowledgeable professional on hand to either help enlist their support or answer specific questions on the particular problems targeted for action. The commitment can include the development of a project plan, or its implementation if a plan has already been formulated. In either case, the state society's willingness to provide the following resources will be helpful:

- publication of data and other necessary information
- staff for volunteer committee or task force
- services of state society lobbyist
- Political Action Committee involvement
- publicity through state magazine and other media

SUGGESTED ELEMENTS OF AN ACTION PLAN

In developing an action plan, several preliminary steps will need to be taken and responsibilities assigned. You will need to determine:

- Who will be responsible for overseeing and conducting various project phases;
- Scope of the data to be compiled;
- Method of data collection:
  — survey of deans
  — phone interviews
  — site visits, etc.;
- Method of data analysis to determine their significance;
- Publication and dissemination of significant results (*note:* reports published by state societies have been the most effective);
- Resources necessary to improve the situation and ways to secure those resources; and
- Policy changes or funding mechanisms most appropriate to your state. (Turn to the case studies section pp. 12, for examples.)

Specific steps that will prove helpful in accomplishing the above tasks are outlined in this section. Again, not every initiative requires all the recommended steps. It is hoped that these suggestions will guide your efforts and provide ideas that can be adapted to your own circumstances.

Phase I. Project Responsibility

Those already involved with successful projects agree that a strong, formal commitment by the state society to a specific study phase plan and action phase plan is absolutely critical because of the resources involved and the political nature of the undertaking.

Once a commitment is obtained, the next step will be to assign responsibility and provide resources to an existing standing committee or establish a new committee for the purpose, being sure to include an engineering dean, a major industry representative (vice-president for engineering or other decision maker), a state society officer, a manufacturer's association member, prominent alumni, a state society Political Action Committee (PAC) representative, and others who can contribute significant political and intellectual influence and have a serious interest in engineering education. While this larger committee can serve in an advisory capacity and participate in specific activities as appropriate, a smaller special task force should be set up to do the majority of the work. Ideally, the state society executive director and lobbyist, president or other leader should be centrally involved. The responsible group should have representation from across the profession so that the project is perceived in the broadest possible light.

Phase II. Program Objectives and Data Collection

Decide what specific problem will be addressed—laboratory equipment needs, faculty salaries, facilities, etc.,—and what you expect to accomplish. Attention should be given to both short- and long-range goals. Before establishing a specific qualitative solution, it is necessary to determine the extent of the problem so that a reasonable solution can be designed and verified. Unless this information is already available, a fact-finding study of the engineering schools in the state has proved essential.

A. *Design of a Fact-Finding Study*

The study should permit your group to determine the present status of the quality of engineering education in your state and then compare it to the national picture. The goal of the study should be to establish the immediate and continuing needs of engineering education to develop and maintain quality programs.

Decide what data/information should be collected and in what form. The engineering deans or other engineering educators should be consulted so that a uniform format for data collection can be designed that can be used by all the universities in your state. Keep in mind that you may want to continue collecting the data on an annual basis to monitor progress. Standardizing definitions and forms will prove helpful. (For an example, see the NSPE Laboratory Equipment Study definitions and forms in Appendix B.)

It is most effective to limit the study to the single issue you wish to address. As is shown in the case studies pp. 12–23, a survey sent to all engineering deans in the state is generally the best method of securing these numbers. The state society office should have the names, addresses and telephones of all the deans.

Supplement the empirical data with anecdotes, based on first-hand observations and information. It is often helpful to compare industrial and commercial facilities and equipment with those at universities.

Keep in mind that your target audience is legislators, not engineers. The data should be organized and presented in a manner that is easily understood by the lay public.

B. *Data Collection*

When collecting, comparing and interpreting the data, be sure to recognize the different types of engineering schools within your state. Primarily undergraduate schools should not be compared with large research universities geared mainly to the Ph.D. level. University catalogs will often provide this information.

Historical data indicating trends in equipment acquisition and renovation, student enrollment, and faculty recruitment and retention will all be helpful in assessing the problems and identifying trends.

NECESSARY DATA AND HOW TO FIND THEM

Depending on what specific problems you intend to address, the following data and information should be secured for each engineering school in the state:

Faculty Salaries

— obtain the maximum, minimum, and average salaries for the ranks of assistant, associate, and full professor;
— determine current entry level salaries for assistant professors;
— compare with salaries offered by industry;
— compare with national and regional salary statistics; (see source documents for the American Society of Engineering Education or the Engineering Manpower Commission in Appendix E).

Student/Faculty Ratios

— collect data in accordance with the following definition: full-time equivalent engineering enrollment/ number of full-time equivalent engineering teaching faculty;
— obtain historical data to illustrate trends;
— use data that were submitted to the Higher Education General Information System (HEGIS), which should be available from the engineering dean's office, the office of institutional research or the president's office.

Student Enrollment and Faculty Positions
— collect data on undergraduate and graduate student enrollments for a ten-year period, if possible;
— identify any changes in admissions or transfer requirements or enrollment limitations;
— collect historical data on faculty positions over the same time period as the enrollment data, and then compare;
— determine the current faculty vacancy situation by rank.

Instructional Resources
— total instructional cost per student credit-hour in engineering can be secured by the engineering dean from the university's HEGIS reports; the amount or percentage of research-generated funds being used to support instruction should be identified;
— determine teaching lab space per junior/senior enrolled, and research lab space per graduate student; distinguish between dedicated and jointly-used space.

Laboratory Equipment
— secure valid input from deans on equipment needs broken into a matrix of the following areas: replacement costs, new technology, workload increase, totals by undergraduate teaching; graduate teaching; research, combination of needs, and overall totals;
— collect equipment inventory data in accordance with the format shown in Appendix B.

Physical Facilities
— if possible, create a list of engineering instructional facilities in the state, including the original construction date, intended capacity, expansion dates, capacities and present enrollments;
— prepare a realistic assessment of the present physical facilities;
— develop a school-by-school list of space needs and projected costs.

Phase III. Data Synthesis and Evaluation

In this stage, data and information should be synthesized and evaluated, with their implication regarding the quality of engineering education made clear. It is important to keep in mind that the factors used to assess engineering education program resources and status do not directly measure program quality. They do measure the resources and conditions which influence the quality of programs. With a resource-poor environment, it is difficult to maintain quality programs.

Rely on the deans of engineering in your state, with verification by the committee, to identify the most critical needs of their respective colleges. Be sure that strong arguments can be made to support the conclusions drawn and the recommendations for action.

Establish a prioritized list of action recommendations to improve the quality of engineering education in your state. Give top priority to the most urgent needs that can be met most readily, given the current economic and political situation. Take care to ensure that none of the suggested solutions are presented as short-term remedies. The program aiding engineering education must respond to the continuing needs of the system, not just immediate concerns.

Phase IV. Report Preparation

A well-written report summarizing the findings and recommendation of the committee, supported by the appropriate data, should be prepared. All the basic data and information should be contained in the appendices of the report, with data sources and definitions clearly cited.

After the report has been reviewed and approved by the state society's executive board, a limited number of copies should be published by the state society. This document will represent the "source document."

An "executive summary" should be prepared from the source document, to highlight the key data, conclusions and their relevance to broader concerns, such as the technological competitiveness or economic growth potential of the state. This summary should be concise, easy to read, and attractive, with the source document referenced and made available. Remember that the principal audience for this publication is outside the engineering community, primarily legislators and their staffs, the media and possibly boards of regents. (Examples of good reports can be obtained from the government affairs office at NSPE headquarters.)

While the ultimate responsibility for preparing and interpreting the report rests with the committee, it is helpful to have an advisory council comprised of prominent industry representatives react to the report, its conclusions and recommendations, and to help assemble political and industry support.

Enough copies for all state house legislators, members of your congressional delegation, major newspapers, key participants in the study, university presidents and engineering deans, and a healthy stock of extras should be printed. You may be able to secure funding from local industry to cover publishing costs.

3 Implementation Of The Action Plan

Once the specific engineering education problem you hope to solve through legislative action has been identified, the working committee or task force will need to determine what legislative changes or actions are desired. Generally, the primary questions are:

- What resources are needed to solve the problem?
- What form should they take?
  — matching grants
  — formula grant allocations
  — tax credits, etc.
- For how long should they be provided?

It is essential that the solution be politically viable, in order to ensure that broad support can be generated in the legislature and in the community.

SET THE STRATEGY

The state society lobbyist, executive director or other professional familiar with the legislative process can best set the legislative strategy. Success depends both upon the strength of the case you build and the way in which it is presented. Even the most accurate data will not lead to legislative action without a clear, well-presented case and a feasible, planned political strategy.

Several mechanisms for providing and allocating engineering education funding have been successfully pursued by a broad range of states. Six such "case histories" are outlined in the next section, and include a copy of the actual bill or legislative language. While in most cases the engineering society relied on legislative staff to draft the actual language, they were armed with fairly specific suggestions of what needed to be accomplished by the legislation.

PREPARE YOUR CASE

To support your report, prepare a one-page summary of the problem, which includes the most significant data, their relevance to broad concerns such as economic development, and the need for action. A one-page outline showing the purpose of the proposed legislation, the funding required, and the intended result should be developed for use in drafting and advocating the bill. Again, these brief outlines of your "case" should reference the executive summary report, which should be included as an attachment when seeking support.

APPROACH STATE LEGISLATORS

The state society Political Action Committee should be involved early on in the political and legislative strategy. Determine which legislators sit on the committees which will need to act on your bill, and be sure those people are aware of the engineering community. Time contributions such that the engineers

will be familiar constituents when you call for an appointment and look for opportunities to contribute to the election campaigns of key legislators. Get to know the staff through less formal, informational sessions on the importance of engineering education problems. It is also helpful to offer the legislators and their staffs opportunities to observe problems first-hand through tours of university and industry laboratories.

It is essential that all lobbying be done by people extremely well-prepared, knowledgeable about the issues and familiar with the politics of the state house. In addition, all persons involved should deliver a consistent message. The most effective strategy will include the broadest range of advocates, with letters, phone calls, testimony and other support coming from engineers working in all practice areas, disciplines, and many other prominent individuals, such as corporate CEOs.

All efforts should be coordinated and organized by one central person, who can track contacts made and keep everyone involved current through regular progress reports. The central coordinator, if kept abreast of all contacts established, can ensure that efforts are not duplicated. Whenever letters to specific legislative committees or legislators are needed, alerts indicating exactly what action is desired and the progress to date should be sent out to all supporters. Legislative staff does respond to constituent pressure—letters, visits and phone calls do make a difference. Try to leverage as much visible support as possible.

ARRANGE FOR PUBLIC RECOGNITION

It is also important to bring visibility to the project, through media contacts, state society and university events and publications, and by calling attention whenever possible to the leadership of key supporters in the state house. Politicians need to know that their work is appreciated by their constituents, and thanking legislators for their help at every step of the process is absolutely essential. Awards, plaques and other public displays of gratitude will encourage the legislators to get involved with the engineers the next time around. Positive reinforcement, even to those legislators who may not have done more than vote for your bill, is the only way to build the sort of relationships that continuing support for your programs demand.

BE DIPLOMATIC

Finally, exercising tact is key throughout the project. For example, university presidents are confronted with a serious deterioration of resources and a skyrocketing need for funds across their campuses. Conducting an effort on behalf of the engineering colleges might be perceived by some presidents as an invasion of their responsibility and authority to allocate resources and determine priorities. Since the president supervises the dean of engineering, this situation could put the dean in an awkward position. Discuss with the dean how best to inform the president and secure cooperation.

For specific examples of strategies and legislation, refer to the state initiatives profiled in the next section. Useful tips for contacting legislators and getting media attention are offered in Appendices C and D.

4 Case Studies: Profiles Of Successful State Legislative Initiatives

NEW MEXICO SUMMARY

KEY PLAYERS:
Engineering Societies Presidents Council (ESPC)
University Deans of Engineering
New Mexico Society of Professional Engineers (NMSPE) Leadership
UNM Associate Vice Provost for Research
NMSPE lobbyist
ASME state government coordinator

SUPPORTING DOCUMENTS:
ESPC Report on Engineering Equipment Needs

PROBLEMS ADDRESSED:
Engineering laboratory equipment needs

PROPOSED SOLUTION:
Five million fund for engineering equipment annually for five years, to be distributed among state's six universities

OUTCOME:
$24 million total over five years for engineering and science equipment; expecting approval of additional $1 million for equipment purchase as well as allocation of funds in amount of 5% of each university's equipment inventory for maintenance

MAJOR OBSTACLE:
Initially, lack of broad based support; later, declining state revenues

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Background

Over the last eight years, several campaigns to improve engineering education have been launched in New Mexico. While the technological climate has remained healthy, changes in the political and economic environment have had a marked effect on the progress being made by the New Mexico engineering community.

With more Ph.D.s per capita than any other state, New Mexico is home to Sandia National Laboratories and Los Alamos National Laboratory, as well as several other major facilities that form the core of the state's technological foundation. Attempts to lure high-tech industry have succeeded in broadening the state's industrial base, although the economy remains dependent on the extractive industries, particularly oil. As a result, the progress made in generating additional funds for engineering education during the early part of this decade has now slowed, reflecting severely declining oil and gas prices.

At the same time that state revenues began to fall, the state elected a liberal, controversial governor, Toney Anaya. Since his election in 1982, the governor has alienated many of his colleagues on both sides of the aisle, and as a result, a conservative coalition has taken power in both houses of the state capital. Spending has grown even more cautious under such leadership, which opposes new taxes and big ticket spending items. However, like many other states, New Mexico is currently in the midst of "educational reform," with legislative committees seeking to better understand and solve educational problems. By linking the state's future technological development to engineering education needs, the New Mexico Society of Professional Engineers has succeeded in obtaining funding for engineering laboratory equipment. Efforts are now directed to securing state support for maintenance.

Development of an Action Plan

In 1978, the dean of the University of New Mexico College of Engineering became convinced that improving the college's engineering laboratory equipment warranted immediate attention. As with other states around the country, investment in equipment had long been delayed, and without quick action, it was clear that the quality of education being offered to students would only further decline. With limited resources and a growing demand for engineering education in the state, the school itself could not provide the needed funds.

To enlist the aid of the engineering community, the dean approached the Engineering Societies Presidents Council (ESPC), which represented the major societies in the state. Under the auspices of an ESPC committee, data was collected from the state's three engineering degree granting institutions. The committee conducted site visits to verify the data submitted and to accumulate first-hand information. A position calling for $5 million in laboratory equipment support was drafted and embraced by ESPC.

Implementation of the Action Plan

In the next legislative session, the NMSPE state lobbyist and executive director helped to get a bill introduced in the session to fund engineering equipment. Although legislation was introduced, opposition to its narrow focus prevented it from getting out of committee. To broaden the base of support, the ESPC Committee presented its report to the Governor's Committee on Technical Excellence (G-Tech), which eventually prompted action. At the suggestion of a senior university official, the ESPC agreed to broaden the plan to include science laboratory equipment, although no comparable independent entity ever made site visits to verify the reported needs.

The new proposal recommended a five-year, $5 million/year fund that would be split between engineering and science equipment. To achieve the widest possible support in the legislature, funds would go to both the major research universities and the smaller four-year schools in the state. The allocation formula was not strictly based on student population, but also reflected actual needs.

G-Tech brought the agreed-upon proposal to the governor in late 1979, and a bill was carried by the Senate leadership in the 1980 legislature. The NMSPE now launched into action, with their and the universities' lobbyists working toward the bill's passage. The ESPC and G-Tech provided testimony, wrote letters and tried to build a solid foundation of support. The bill was passed that year and signed into law.

Continued Funding

Although the original legislation did not explicitly require funding for the following four years, all lobbying had stressed the importance of a five-year commitment. By returning in 1981 and continually emphasizing the need for ongoing support, the five-year approach became accepted by all. For the first three years, severance tax bonds supplied the $5 million with no opposition. However, as state revenues began to fall and the governor started to generally encounter resistance from the legislature, it became clear that without a carefully planned lobbying strategy, the fifth $5 million installment would be easily lost.

The NMSPE lobbyist worked to see that at every step the bill was kept alive. Several hurdles were overcome, and at literally the 11th hour, the $5 million was reduced to $4 million and attached to one of the large bills that was going through. NMSPE sought and received a commitment from key legislators to keep the engineering equipment funding included. The $4 million was approved.

Allocation of Funding

It was important throughout the process to maintain the integrity of the monies. To make certain that the funds were spent in strict accordance to the legislative intent, the University of New Mexico Associate Provost for Research was designated the liaison between the G-Tech and the six universities. Each university documented expenditures, uncommitted funds, leveraged income, research grants and other items that would support the subsequent year's funding request.

ILLINOIS SUMMARY

KEY PLAYERS:
Illinois Deans Council
Illinois Society of Professional Engineers (ISPE) executive director/lobbyist
Legislative intern

SUPPORTING DOCUMENT:
Engineering Education in Illinois—Quality on the Decline

PROBLEMS ADDRESSED:
Engineering laboratory equipment needs

PROPOSED SOLUTION
State/private sector matching grant fund

OUTCOME:
Fund established; legislature appropriated $500,000 for FY '84, $700,000 for FY '85, and $1 million for FY '86

MAJOR OBSTACLE:
Lack of state funds, tight economy

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Background

While Illinois has historically been known for outstanding public engineering schools, in recent years state funds for engineering education began to decline, raising the concern of the Illinois Society of Professional Engineers, and especially the engineering deans. The Illinois deans and the ISPE leadership have long held annual meetings to discuss issues of mutual interest, and at such a session in 1982 the issue of state support of engineering education was raised. As a result, it was agreed that the Society would undertake a major legislative effort aimed at generating funding for engineering laboratory equipment, which the deans had identified as the most urgent area of need. The Society offered the expertise of its professional lobbyist and legislative intern, including the preparation and printing of a concise, factual report on the engineering education situation in Illinois. The deans prepared to make facts and figures available, and served as advisors throughout the project.

The economic climate of Illinois presented the Society with a real challenge. Home to traditional smokestack industry, Illinois' companies faced stiff competition from abroad and in many cases were struggling to keep afloat. While that environment was clearly not conducive to corporate philanthropy, the Society believed that private sector support was an essential ingredient for success. By linking the future technological competitiveness of the state's industry to engineering, ISPE was able to generate support for the concept of a matching grant program. Today, the program established through ISPE's efforts is responsible for over $2 million of laboratory equipment funding that has been approved by the state legislature.

Development of an Action Plan

Following the ISPE/Deans Council meeting, ISPE's executive director and legislative intern began to collect information from the deans on the laboratory equipment needs of each engineering school in the state, as well as other relevant facts and figures that document the importance of providing increased funding for engineering education. The final report, *Engineering Education in Illinois—Quality on the Decline,* was issued in March, 1982. The report clearly showed why the state could no longer afford to postpone investment in engineering education (see box).

ENGINEERING EDUCATION
IN ILLINOIS

— Quality on the Decline —

Illinois Society of Professional Engineers
1304 South Lowell Avenue
Springfield, Illinois 62704

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To begin sensitizing the legislature to the problem, the report was sent to every legislator with a cover letter from ISPE. During the following year, personal follow-up visits were made to key individuals, with the purpose of soliciting interest in sponsoring a bill. Support was also sought from the governor, the Illinois Board of Higher Education, and industry leaders. With a republican governor and a democratically-controlled legislature, support from leading political figures was especially important, as political posturing often substituted for meaningful debate.

Implementation of the Action Plan

By early 1983, ISPE had secured a commitment from a key legislator to introduce a bill. The proposal called for a one to one state/private sector matching grant program for engineering laboratory equipment at the state's four public and four private universities. The Senate Appropriations Committee chairman proved to be a key figure in leading the bill successfully through the legislative process, as most major funding decisions in Illinois are made behind closed doors in a Conference Committee. Without someone on this Committee to fight for your program, it is nearly impossible to get funding. Working with this senator and other key players, ISPE's executive director/lobbyist made sure that the bill was high on the legislature's agenda for the session, and succeeded in building a broad coalition of support for the measure. It was passed into law that same year, even though the Board of Higher Education had taken a neutral position.

Outcome

In the first year of funding, the bill appropriated $500,000 as requested. The second year, 1984, resulted in approval of $700,000, and in 1985, a full $1 million was cleared. Combined with the matching support leveraged by the state contributions, ISPE's efforts have led to total investment of $4.4 million to date. Given the ever-increasing importance of engineering to the state's economic health, the future may bring even further rewards.

MISSOURI SUMMARY

KEY PLAYERS:
- Missouri Society of Professional Engineers (MSPE) president
- MSPE Task Force on the Role of Engineers and Engineering Educational Institutions in Missouri's Developing High-Tech and Industrial Economy
- MSPE executive director/lobbyist
- Industry leaders
- Missouri engineering deans

SUPPORTING DOCUMENTS:
- *Engineering Laboratory Equipment: A Crisis in Missouri*

PROBLEMS ADDRESSED:
- Engineering laboratory equipment needs

PROPOSED SOLUTION:
- State grant program based on number of bachelors degrees awarded with private sector matching provision

OUTCOME:

Bill passed into law that establishes a grant program for instructional and research engineering equipment at $2,400 per bachelors degree awarded; includes matching provision

MAJOR OBSTACLE:

Concern that bill would establish precedent of line-item funding for one program within university system; opposition of university presidents

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Background

After years of searching for the best approach to address increased resources for engineering education in the areas of faculty salaries, facilities and laboratory equipment, the Missouri Society of Professional Engineers found the political climate right in 1984. Missouri was one of many states competing for high-technology industry, especially the well-publicized General Motors Saturn Plant, and the governor was actively seeking opportunities to bring new companies and technology into the state.

Although problems with the state budget were having the affect of constraining funding for all higher education, MSPE members believed that engineering education was not getting an appropriate share of the limited funds available to the universities. In Missouri, the entire state university system receives a lump sum from the state legislature which university officials then divide among the campuses and colleges. To expand engineering education funds therefore required either a new and separate appropriation just for that purpose, or a reprogramming of overall university dollars.

During the previous ten years, engineering enrollment had doubled in Missouri's state-supported engineering schools, while the budget, corrected for inflation, remained approximately constant. The purchasing power per engineering student decreased dramatically. Without an infusion of new funds, it was clear that the quality of education could only decline.

Given that situation, MSPE decided early on to pursue a special legislative fund for engineering education. The Society's leadership, including the deans of the major engineering colleges, worked closely with prominent corporate CEO's and other high level Missourians to convince the legislature and governor that such a program was needed to maintain and improve the technological capabilities of the state. Concerned that such a move would usurp their budget priorities, the university presidents were opposed to the measure from the start. With a broad coalition of engineers and industry leaders and a well-organized lobbying campaign, the MSPE succeeded in getting the bill passed in just one year.

Development of an Action Plan

In order to get the project off the ground, the MSPE president established the Task Force on the Role of Engineers and Engineering Educational Institutions in Missouri's Developing High-Tech and Industrial Economy. Members of the task force and chief executive officers of key Missouri companies began spreading the word about the severity of engineering education problems and the important link between those needs and a strong technological climate at interim committee hearings of the Missouri General Assembly. Their statements are best exemplified by that of Earl K. Dille, P.E., Executive Vice

President of Union Electric Co., who said, "our governor can travel to Japan, Germany or China and find out what they are doing, but until we furnish a fertile academic and technological climate in Missouri for high-tech industries, they simply will not grow here."

In developing their strategy, the task force decided not to wave the loss-of-accreditation flag even though the Accreditation Board for Engineering and Technology had indicated in previous visits that Missouri engineering schools were in desperate need of resources to provide laboratory facilities in non-computer areas. They felt that by focusing entirely on the economic and technological importance of engineering education, it would be more likely that the legislature would be convinced to provide funding. From the start, therefore, all arguments were based solely on the need to produce engineering graduates capable of meeting the challenge of the state's industry and with the expertise required by the research demands of those companies.

In the fall of 1984, the task force decided that laboratory equipment needs took top priority, and that this issue would also be politically viable. MSPE's executive director/lobbyist worked with the task force to draft legislation, find sponsors and then prepare a white paper that would document and define the needs. Based on the successful efforts of the Illinois Society (see p. 0–0), MSPE drafted a bill that followed the same $2,400/bachelor degree awarded formula, citing enactment of similar legislation by Illinois.

The proposed bill would add a new section to Missouri law providing grants to engineering colleges of the University of Missouri to assist them in purchasing instructional and research laboratory equipment. In the first year, outright grants would be funded based on the number of graduates, as in Illinois. The amount of grants in subsequent years would be determined by the amount of matching non-state funds generated with a per degree ceiling. Because it called for line-item funding of a specific university program, MSPE knew the legislation would be controversial, and prepared for the campaign.

Implementation of the Action Plan

A white paper was prepared to justify the need for legislation, with engineering schools providing background information, budget charts and projected needs. Entitled *Engineering Laboratory Equipment: A Crisis in Missouri*, the paper was published by the Missouri Society in December of 1984. Next, key legislators were sought to sponsor bills in both the House and Senate. Since the bill would have to go through both the Education and Budget Committees before it could reach the floor, MSPE wanted sponsors from those two committees as well as influential legislators who could assist during floor debates.

As soon as it was introduced, the legislation attracted the interest of industrial leaders across the state who offered their time and expertise through phone calls, letters and testimony. Approximately 150 MSPE members and other interested individuals were organized by the president. Action was requested as appropriate throughout the legislative process, with the executive director/lobbyist keeping the group appraised of all developments and opportunities for action at each step.

Although no major organization opposed the bills during committee hearings, the legislation did not have the support of the university system. Some lawmakers also were concerned about the propriety and long-term consequences of sidestepping the standard appropriations process, and were especially worried that it would set a precedent for other schools within the university system.

Because the Senate bill moved rapidly, the House bill was allowed to die. The intent of the bill remained intact, but through the long and complicated process, two changes were made. The final bill included a "based on available funds" clause and a termination date of June 30, 1990. However, a provision was retained stating that if funds are unavailable, all grant programs are to be pro-rated.

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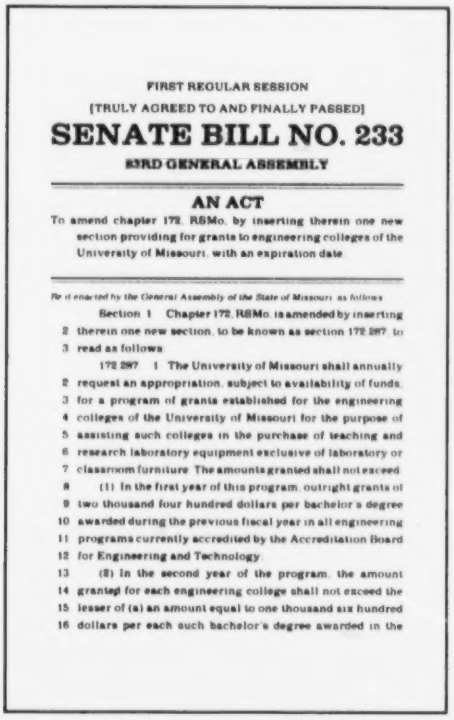
Outcome

Both the Senate and the House passed the bill by wide margins, but to become law it required the governor's signature as well. Concerned that an apparent delay was due to concern over precedent setting, the MSPE president and other key officials requested a meeting with the governor to discuss the importance of the measure to Missouri's educational and economic programs. They succeeded in convincing him, and the bill was signed just one day prior to the deadline.



FIRST REGULAR SESSION

[TRULY AGREED TO AND FINALLY PASSED]

SENATE BILL NO. 233

83RD GENERAL ASSEMBLY

AN ACT

To amend chapter 172, RSMo, by inserting therein one new section providing for grants to engineering colleges of the University of Missouri, with an expiration date.

Be it enacted by the General Assembly of the State of Missouri, as follows:

Section 1. Chapter 172, RSMo, is amended by inserting therein one new section, to be known as section 172.287, to read as follows:

172.287. 1. The University of Missouri shall annually request an appropriation, subject to availability of funds, for a program of grants established for the engineering colleges of the University of Missouri for the purpose of assisting such colleges in the purchase of teaching and research laboratory equipment exclusive of laboratory or classroom furniture. The amounts granted shall not exceed:

(1) In the first year of this program, outright grants of two thousand four hundred dollars per bachelor's degree awarded during the previous fiscal year in all engineering programs currently accredited by the Accreditation Board for Engineering and Technology;

(2) In the second year of the program, the amount granted for each engineering college shall not exceed the lesser of (a) an amount equal to one thousand six hundred dollars per each such bachelor's degree awarded in the previous fiscal year, or (b) twice the dollar value of new funds for equipment purchase which such colleges may obtain from sources other than state appropriations for laboratory equipment;

(3) In the third and succeeding years of the program, the amount granted for each engineering college may not exceed the lesser of (a) an amount equal to one thousand two hundred dollars per each such bachelor's degree awarded in the previous fiscal year, or (b) the dollar value of new funds for equipment purchase which such colleges may obtain from sources other than state appropriations for laboratory equipment.

2. For purposes of this section, the fair market value of in-kind contributions of laboratory equipment to the colleges may be included as funds for equipment purchase from sources other than state appropriations. In the event that new funds for laboratory equipment purchase obtained by any college of engineering from such nonstate sources exceed the amount necessary to reach the maximum dollar limits herein specified for the second and each of the following years of this program, such excess amounts will be carried over to the following fiscal year and considered the same as that year's new equipment funds from nonstate sources.

3. In the event that the appropriations for this grant program are insufficient to fund all grants approved for a given fiscal year, all such grants shall be reduced pro rata as necessary.

4. The provisions of this section shall terminate on June 30, 1990.

PENNSYLVANIA SUMMARY

KEY PLAYERS:

Pennsylvania Society of Professional Engineers (PSPE) leadership
Association of Engineering Colleges of Pennsylvania
State Department of Education
State Department of Commerce
PSPE executive director/lobbyist

SUPPORTING DOCUMENTS:

An Analysis of Currently Held Engineering Equipment and Engineering Equipment Needs at Selected Pennsylvania Institutions of Higher Education

PROBLEMS ADDRESSED:

Engineering laboratory equipment needs

PROPOSED SOLUTION:
State/private sector matching grant fund

OUTCOME:
Bill passed in 1984 that provided $3 million for 3/1 matching fund for engineering equipment. The next year, a $16.5 million program was approved to fund laboratory equipment for any academic department, at discretion of provost.

MAJOR OBSTACLE:
Administration proposed controversial funding mechanism

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Background

Because the economic health of Pennsylvania is largely tied to heavy industries such as steel, new and improved technology is vital to the state's future welfare. A leader in the development of innovative programs to spur advanced research and technology transfer, Pennsylvania is home to several prominent engineering schools. The quality of educational programs is generally considered to have a direct effect on the state's capability for economic recovery and advancement.

In the fall of 1983, the Pennsylvania Society of Professional Engineers joined forces with the Association of Engineering Colleges of Pennsylvania (AECP), a loosely formed confederation of the state's engineering deans, to evaluate engineering education needs and explore possible solutions. It was decided that with AECP supplying technical support and data and PSPE's political clout and lobbying capability, a legislative effort initiative would be mounted to generate state support for engineering equipment.

Development of an Action Plan

The effort began by PSPE organizing a meeting with the Association of Colleges and Universities, the state departments of Education and Commerce, and AECP. The group agreed that the first step should be to develop and conduct a survey of engineering laboratory needs in the state's engineering schools. A survey was designed which was limited to undergraduate instructional equipment in ABET-accredited programs, and included private as well as state-supported institutions. In order to ensure the credibility of the results, the survey was conducted by the Department of Education. The final product, *An Analysis of Currently Held Engineering Equipment and Engineering Equipment Needs at Selected Pennsylvania Institutions of Higher Education*, was published by the Department of Education in January of 1984. To achieve state-of-the-art status, a total need of approximately $72 million was found.

Implementation of the Action Plan

The analysis was distributed to the governor's office, legislators, and other key leaders. The PSPE lobbyists then sought the assistance of the administration, urging that an engineering equipment appropriation be included in the 1984–85 budget that would be submitted to the legislature. Since the administration essentially documented and validated the needs, this approach seemed particularly viable. The governor did propose a $50 million initiative, but tied it to a controversial funding mechanism that hinged

on the state divesting its liquor stores. Although it was clear that there was broad support for addressing the engineering education issue, the suggested funding route was doomed from the start.

Outcome

The administration's recognition of the problem did, however, provide PSPE and the deans with a platform, and it was decided that another, more viable approach would be pursued. PSPE lobbied to have funds for engineering equipment included in an Economic Development Initiative, which was sure to move through the legislature. In June of 1984, a $3 million, 3 to 1 matching grant program was approved and passed into law, with the state contribution raised through the sale of bonds. All institutions with ABET accredited programs could participate, marking the first time that the Commonwealth of Pennsylvania appropriated funds to non-state supported schools.

That fall, the AECP updated and reprinted the survey, and again distributed the results. The governor proposed another major initiative, but again proposed that the funding be linked to liquor state divestiture. Combined with the fact that the $3 million was still being allocated, there was little support for this program, and especially for an effort earmarked just for engineering.

As an alternative, PSPE threw its weight behind a more broadly defined bill, which granted all Pennsylvania institutions of higher education an aggregate sum of $16.5 million. These funds were to be spent on laboratory equipment, in any department at the provost's discretion. This legislation carried a much wider base of support in the legislature, and in June of 1985, it became law. To maximize the opportunity for engineering colleges to benefit from the program, PSPE sent a letter immediately following passage of the legislation urging the deans to make their requests for support early.

While a great deal of progress has been made, the needs have only begun to be met. Hoping to continue their record of success, PSPE and AECP are now instituting a 1986 initiative.

MICHIGAN SUMMARY

KEY PLAYERS:
- Michigan Society of Professional Engineers (MSPE) in Education
- MSPE Task Force on Engineering Laboratory Equipment in Michigan Universities
- MSPE executive director/lobbyist
- Michigan Engineering Deans Council

SUPPORTING DOCUMENTS:
- *The Engineering Laboratory Equipment Crisis in Michigan Universities*

PROBLEMS ADDRESSED:
- Engineering laboratory equipment needs

PROPOSED SOLUTION:
- State appropriations for engineering research and instructional equipment; grant program allocating $2,400 per bachelors degree awarded previous fiscal year

OUTCOME:
- Governor recommended $12 million investment in research and instructional equipment, legislature appropriated $4 million for 1985 and $5 million for 1986; new bill introduced for 1986 session

MAJOR OBSTACLE:
Initially had budget deficit

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Background

The state of Michigan has long been a technological center. Home to the engineering-intensive automotive industry, Michigan's economic well-being depends to a large extent on the health of the industry. Because of the clear importance of engineers to the state, the Michigan Society of Professional Engineers has been able to attract the attention and support of the corporate community as well as key policy makers in their efforts to initiate a legislative strategy to generate state funds for engineering education.

After years of decline, Michigan's economy is now on the upswing. The state budget is the largest in history, following a major tax increase which brought the state out of debt. The governor and state legislature are actively promoting additional appropriations for education and technology, providing the Michigan Society with an exceptionally favorable climate to seek engineering education funds. After completing a comprehensive report, the Society successfully lobbied for new appropriations for instructional engineering equipment in 1984, which was repeated in 1985. A more comprehensive, long-term legislative proposal has now been developed, which will be considered during the 1986 session of the state legislature.

Development of an Action Plan

Beginning in 1983, the Michigan Society of Professional Engineers has been seeking ways to document and improve engineering education in the state's ten engineering schools. In that first year, engineering laboratory equipment inadequacies were identified as the prime issue by the engineering deans. To define the problem and develop a factual base for further actions, the Society's Professional Engineers in Education (PEE) division conducted a survey of Michigan universities. The survey produced a total dollar need for each university in order to bring the engineering laboratories up to a 1983 technology level and to be fully operational by the 1983–84 year. According to the results, over $86 million was required. It was found that to keep engineering laboratories and equipment current, $10 million would be needed on an annual basis.

These results were published in a complete report, *The Engineering Laboratory Equipment Crisis in Michigan Universities*, which was printed by the Society. The report was distributed to all members of the state legislature, as well as other key policy makers and industrial leaders in the state. In addition, NSPE sent copies to all members of the Michigan congressional delegation in Washington. In the fall of 1984, NSPE established a task force to update the 1983 report and validate the results. The task force members were all affiliated with private practice, industry, and state government. Over a two month period, Task Force members visited each of the ten Michigan engineering colleges to inspect various engineering laboratories and existing equipment, and to review and discuss the equipment lists that were proposed by the deans of each college. These visits confirmed the urgent need for funds to modernize laboratory equipment at all of the schools.

Implementation of the Action Plan

All of this information was shared with the Governor's Commission on the Future of Higher Education in Michigan, which was established in 1983 for the purpose of identifying the major needs and priorities in higher education. The Commission issued its final report in December 1984, citing much of the data and conclusions included in MSPE's report. The Commission recommended a major $12 million initiative on laboratory equipment (see below). At legislative hearings throughout 1985, MSPE testified on engineering education problems, with the task force presenting the MSPE report to the Select Committee on Higher Education, which reviewed the findings and recommendations of the Commission.

> ". . . in order to validate the need, the Commission asked the Michigan Society of Professional Engineers to examine deferred maintenance needs at our public colleges and universities. Teams of independent engineers visited five universities and conducted an extensive review of their maintenance requests. The Society identified a backlog of deferred maintenance projects of about $50 million at the five universities visited. The Commission feels that when the other ten, mostly smaller campuses are considered, the actual total college and university deferred maintenance need is about $90 million."
>
> "Maintaining the Physical Structure"
>
> ". . . Critical needs exist for more sophisticated and updated equipment in all areas of instruction. The Michigan Society of Professional Engineers has estimated, for instance, that the laboratory equipment needs for the engineering schools alone could exceed $70 million. In another example, one of the state universities has documented a critical need for the replacement of industrial arts equipment that is substantially out of date. These needs are being underscored as, increasingly, employers are highlighting the need for students to be trained on up-to-date equipment."
>
> "Updating Instructional Equipment and Resources"
>
> *The Governor's Commission on the Future of Higher Education in Michigan, 1984*

Outcome

Initially, MSPE pursued state appropriations for engineering laboratory equipment, based upon the documented $86 million need. For 1985, the legislature approved a $4 million appropriation, although its use was broadened to both science and engineering equipment. The funding level was raised to $5 million the following year. A more comprehensive bill is now being developed by the MSPE task force with the assistance of the Chairman of the Senate Committee on Higher Education and Technology. As proposed, the legislation will establish a five-year grant program for public engineering schools. The program would fund outright grants of $2,400 per bachelors degree awarded by the engineering college during the previous fiscal year in all accredited engineering programs. These appropriations would be used strictly for instructional and research equipment.

In addition, the proposed legislation would mandate a comprehensive study of the future needs of the full engineering team, from technicians to engineers. The effort has already sparked the interest and support of community colleges, technical schools and other partners in the engineering team, and the MSPE lobbyist expects that the chances for passage will be greatly enhanced by this broad community of support.

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Appendix A
USEFUL FACTS AND FIGURES

Supply and Demand

- The Bureau of Labor Statistics projects a 48 percent engineering job growth between 1982 and 1995.
- The number of engineering bachelor degrees earned in the United States has increased steadily from 37,000 in 1976 to 76,391 in 1984, an increase of over 100 percent in eight years. (*Engineering Manpower Bulletin*, AAES, 1984.)

Faculty Shortage

- The total number of doctoral engineers employed in teaching increased less than 30% from 1973 to 1983, while those in consulting nearly tripled and those in professional services more than quadrupled during the same period. (*Science and Engineering Personnel: A National Overview*, NSF, 1984, Table of employed doctoral scientists and engineers by field, sex, and selected primary work activity: 1973–1983.)
- Faculty vacancies and increased enrollments have caused student/faculty ratios to increase 37 percent between 1976 and 1982. (*Survey of Engineering Faculty and Graduate Students*, ASEE, July 1984.)
- The percent of foreign nationals earning doctoral degrees in 1984 reached 54 percent of all engineering degrees awarded. (National Science Foundation and National Research Council.)
- Approximately 7,000 faculty members will retire over the next 15 years—an average of about 450 per year. (Report of the Panel on Graduate Education and Research, National Research Council, in preparation.)
- The starting salary of a new BSE graduate in industry ranges from $25,000 to $30,000; graduate student stipends are less than $10,000 (*Income and Salary Survey, 1985*, National Society of Professional Engineers; Report of the Committee on the Education and Utilization of the Engineer, National Research Council.)
- An entry level position in academe earns a new Ph.D. about $30,000; that same engineer could command a starting salary of about $43,000 in industry. (*Income and Salary Survey, 1985*, National Society of Professional Engineers.)

Laboratory Equipment

- Twenty-five percent of the research equipment in engineering colleges is obsolete. (*Academic Research Equipment in the Physical and Computer Sciences and Engineering*, National Science Foundation, December 1984.)
- The median age of [laboratory] instruments in the schools is about twice that of industry instrumentation. (Report of the Committee on the Education and Utilization of the Engineer, National Research Council, 1985.)

Industrial Comparisons

- Ten years ago, with only 5 percent of the world's population, the U.S. was generating 75 percent of the world's technology. Today the U.S. share has declined to 50 percent.
- From 1962–1980, Japan's share of world exports of high technology products increased from 4 to 14 percent. The U.S. market share dropped from 32 percent in 1962 to 27 percent in 1974, and has not changed significantly since then.
- Japan has six times as many engineers per capita than the U.S. The U.S. has 13 times as many lawyers and 20 times more accountants per capita than Japan.

Appendix B
NSPE/PEE
LABORATORY EQUIPMENT STUDY
DEFINITIONS AND CLARIFYING INSTRUCTIONS

In an effort to make the data from various schools as comparable as possible please use the following information when compiling your data. There are two data forms. The "General Data" form applies to the entire school or college and only one form should be filled out by each college. The second form is "program specific" and one form should be filled out for each degree program. *All* laboratories that are *college-wide* or *multi-departmental* should be reported together *on one form.*

GENERAL DATA

Number of FTE Undergraduate Students:

This is the number of semester credit hours (SCH) generated by courses *in your college* in the Fall 1985 semester divided by 15. This is a measure of the instructional load of your faculty. One student taking a 3 semester hour load for one semester accounts for 3 SCH's. If your institution is on an academic term other than semesters, please make the appropriate conversion and report your data on a semester basis.

College-Wide Laboratory Fee

If you have an engineering laboratory fee (or fees) that is charged to all students, please calculate the total fees the students pay, divide by 8, and report it as an amount/semester. This includes fees for engineering lab use, computer use, equipment assessment, lease charges, etc.

Expected Useful Lifetime of Equipment

This is a qualitative measure but one that is important for projecting equipment resource needs over a period of years. "Useful lifetime" should be interpreted to be the length of time the equipment will be of any significant value as a part of a student laboratory. Many student measurements for instance do not require use of the most recent advances in measurement technology and a five year old piece of equipment is entirely satisfactory.

Number of FTE Technicians

We are trying to isolate the "computer" factor in the overall laboratory equipment problem. If some technicians work in both computer and non-computer environments, please make your best estimate of the division of their time when reporting these data.

Computer Maintenance Costs:

Please include all costs associated with *maintaining* all the computer equipment in your college *except* the salaries and associated overhead of the technicians reported in the preceding question.

PROGRAM-SPECIFIC DATA

Program:

This is the official name of the degree program being reported on this form. If college-wide (e.g. computer graphics) or multi-departmental (e.g. hydraulics) labs are being reported on this form put "COLLEGE-WIDE" in the space. Remember all college-wide and multi-departmental labs are to be combined and reported on one form.

Amount Spent By Funding Source:

We are attempting to identify the sources of funds spent as well as the amount. "Other governmental" would include direct allocations of lab funds from state legislatures. "Institutional" are those funds supplied at the discretion of the institution, College or department for lab equipment. "Individual and Industry Philantropic" are cash gifts used for equipment purchase. "Industry In-kind" is the value of actual equipment donated by industry to this program. Do not report equipment purchased through externally funded research contracts.

If you have any questions about the data requested in this survey, please contact one of the following individuals:

Neil Schmitt, University of Arkansas	(501) 575-3054
Joe Genin, New Mexico State University	(501) 646-5698
Halit Kosar, Gannon College	(814) 871-7616
Don Leigh, University of Kentucky	(606) 257-1687
Ralph Warburton, University of Miami	(305) 284-3438

Please use the enclosed envelope to return the questionnaire to:

Neil M. Schmitt
Dean of Engineering
E-204
University of Arkansas
Fayetteville, AR 72701

Appendix B
A Questionnaire Concerning
Problems in Engineering Education
The Laboratory Equipment Factor

for a study by

THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS
PROFESSIONAL ENGINEERS IN EDUCATION

GENERAL DATA

(Answer for the entire college)

City/State _____

Number of FTE Undergraduate Students (Fall semester SCH/15) _____

Number of Authorized Faculty Positions _____

Number of Undergraduate Degree Programs _____

Do you charge a college-wide laboratory fee?

_____ Yes _____ Amount/semester _____ No

Does your campus charge additional tuition for Engineering students?

_____ Yes _____ Amount/semester _____ No

Do you require Freshmen to purchase a microcomputer?

_____ Yes Brand _____ Retail Value _____ _____ No

What is the average expected useful lifetime of your *new* lab equipment, excluding computers? _____ Years

What is the average expected useful lifetime of your *new* computer equipment? _____ Years

Number of FTE technicians used to operate, maintain, manage lab equipment, excluding computers? _____

Is this number satisfactory? _____ Yes _____ No Number needed _____

Number of FTE technicians used to operate, maintain, manage computer equipment? _____

Is this number satisfactory? _____ Yes _____ No Number needed _____

What are the total maintenance costs per year for all computers in your college? (including service contracts, overhead burden, components, etc., and excluding technician salaries)

Hardware maintenance/year $ _____ Software maintenance/year $ _____

Name of person completing the questionnaire _____

Title _____ Telephone _____

Program – Specific Data

(Complete one sheet for each degree program and one sheet for college-wide labs)

PROGRAM: _____

Amount Spent (by Funding Sources) for Instructional Lab Equipment ($1,000's) (Excluding Computers)

Year	Federal	Other Governmental	Institutional	Individual Philanthropic	Industry Philanthropic	Industry In-kind	Total
1981–82							
1982–83							
1983–84							
1984–85							

Amount Spent (by Funding Sources) for Computer Equipment ($1,000's) (Hardware and Software)

Year	Federal	Other Governmental	Institutional	Individual Philanthropic	Industry Philanthropic	Industry In-kind	Total
1981–82							
1982–83							
1983–84							
1984–85							

BS Degrees Awarded By this Program

1981–82 _____

1982–83 _____

1983–84 _____

1984–85 _____

Estimated current value of lab equipment: $ _____

Estimate of amount needed to make all equipment in labs in this program "state-of-the-art": $ _____

Appendix C
HELPFUL HINTS IN CONTACTING LEGISLATORS

Letters and phone calls that communicate the interests and concerns of constituents are the primary means that legislators have to gauge local opinion. By providing your professional views to policy makers, you are adding a perspective that might otherwise be absent. To maximize the impact of your efforts to inform and influence legislators, the following guidelines should be followed.

Forms of Address

The Honorable Jane Doe
address

Dear Representative, Senator, Assemblywoman Doe:

Letter Format

Letters should be concise, factual and legible. Use personal or professional letterhead, and include a return address if it is not printed on the stationery. If possible, keep your letter to one page.

Points to Make

"MY NAME IS . . . I AM WRITING ON BEHALF OF THE . . ."

— Identify yourself. If you are writing on behalf of an organization or company, be sure to say so, and include a brief description. Your letters will carry more weight if you reside or do business in the legislator's district. Let your elected official know you are writing as a constituent, not simply as a concerned American.

"I AM WRITING TO URGE YOU TO (SUPPORT/OPPOSE) (BILL #) BECAUSE . . ."

— Explain what position you are advocating, and why.
— State facts, using statistics to support your statement of the problem.
— Tell how the legislation will affect you, your business, and the engineering profession.
— Clearly relate the problem and proposed solution to local concerns.
— Never assume the legislator knows as much about the problem as you do.
— Be polite, positive and constructive. Do not threaten or be sarcastic.
— Never send a postcard or form letter.
— Use examples from your own experience.

"IN CONCLUSION, I URGE YOU TO . . ."

— Repeat your reason for writing.
— Thank the legislator for his/her cooperation.

Do not assume your letter will not be read—it will!

Appendix D
HELPFUL HINTS IN CONTACTING THE MEDIA

One way to reach important decision makers and the public-at-large is through the media. If a story is important to the public welfare it will be important to reporters. It is up to you to translate your story into one of public interest, thereby gaining media attention.

Get Their Interest

When you present a news or feature story idea to the local media ask yourself: why should they care? what impact does my story have? what is new, different or exciting about this story?

Send Out Advance Notice

If you sponsor a newsworthy event notify the media four or five days in advance. Send a written advisory that is one page, typed, double-spaced. Be sure to include the who, what, where, when and a brief how of the activity. Don't forget to list your name and telephone number.

Contact the Right Person

The type of event you're planning will determine to whom you should send your advisory. In general, though, television notices should go to the assignments editor. For radio, contact the news editor. For newspapers, try the city editor or for specific education news, contact the education or business editor, depending on the story's focus.

Follow Up

Two days before the event, follow up your written advisory by phone. Be prepared to provide background information and justify why the reporter should cover your event.

Watch Your Timing

Remember that news is a business, one full of deadlines. Be conscious of these deadlines when you phone or schedule an event. For example, don't call a newspaper's business editor at 3 p.m. S/he is on deadline and won't have time to talk.

During an event, don't expect reporters to stay until the end. Be sure the important part of your program is up front and there is time for questions and answers.

* * *

You don't have to sponsor an event to meet with reporters. If there is an issue or information you would like to discuss, call a reporter or editor and ask for an appointment or have lunch together.

If you would like further assistance, contact the NSPE Public Relations Office (703/684-2855) or the Information Center (703/684-2810) to request a public relations kit.

Appendix E
Useful Source Documents

American Society for Engineering Education. 1983. Survey of Engineering Faculty and Graduate Students.

American Society for Engineering Education. 1984. Policy statement endorsed by the Executive Committee of the Engineering Deans' Council.

American Society for Engineering Education, Statement by Dr. W. Edward Lear before the House Science Policy Task Force, Committee on Science and Technology, July 23, 1985.

American Society for Engineering Education. Quality in Engineering Education Project, in preparation.

Engineering Manpower Commission. 1983. Salaries of engineers in education.

Engineering Manpower Commission. 1984. Engineering Manpower Bulletin, December. (Comparison of B.S., M.S., Ph.D. degrees earned, 1952–1984).

National Association of State Universities and Land-Grant Colleges. 1984. Appropriations: State Tax Funds for Operating Expenses of Higher Education 1984–1985.

National Science Board. 1984. Educating Americans for the 21st Century: A Report to the American People and the National Science Board. Washington, D.C.: National Science Foundation.

National Science Foundation. 1984. Academic Research Equipment in the Physical and Computer Sciences and Engineering.

National Science Foundation. 1984. Science and Engineering Personnel: A National Overview.

National Society of Professional Engineers. 1985. Income and Salary Survey.

National Society of Professional Engineers, Statement by Donald G. Weinert, before the House Science Policy Task Force, Committee on Science and Technology, July 24, 1985.

National Research Council. 1985. Engineering Education and Practice in the United States: Foundations of Our Techno-Economic Future.

National Research Council. Report of the Panel on Engineering Employment Characteristics, in preparation.

National Research Council. Report of the Panel on Graduate Education and Research, in preparation.